PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	THOMAS I. INSLEY et al.	**Examiner:**	Leo, L.
Serial No.:	09/099,632	**Group Art Unit:**	3743
Filed:	June 18, 1998		
For:	MICROCHANNELED ACTIVE FLUID HEAT EXCHANGER	**Docket No.**	27987-208414

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Jolene Alger

APPEAL BRIEF

The Applicants filed Notice of Appeal in this application on April 1, 2002 from the final rejection of the Examiner dated December 31, 2001. As March 31, 2002 fell on a Sunday, the Notice of Appeal was timely filed within the three-month shortened statutory period.

This Appeal is proper because the present application includes claims that have been finally rejected. Applicants' Brief in support of this Appeal follows.

REAL PARTY IN INTEREST

The real party in interest in this Appeal is 3M Innovative Properties Company, the assignee of all rights to the invention disclosed in the subject application. An assignment of the inventors' rights to Minnesota Mining and Manufacturing Company was recorded in the United States Patent and Trademark Office on June 18, 1998, at Reel 9273, Frame 0220.

Subsequently, an assignment from Minnesota Mining and Manufacturing Company to 3M Innovative Properties Company was recorded in the United States Patent and Trademark Office on February 28, 2002.

RELATED APPEALS AND INTERFERENCES

There are no known appeals or interferences related to this Appeal.

STATUS OF THE CLAIMS

The present application is a Continued Prosecution Application, based on parent application Serial No. 09/099,632 filed June 18, 1998, entitled "MICROCHANNELED ACTIVE HEAT EXCHANGER" which has been expressly abandoned.

The parent application was originally filed with claims 1-30. In an Office action dated August 11, 1999, the Examiner required restriction between claims 1-25 and claims 26-30. In a response dated September 13, 1999, Applicants elected to prosecute claims 1-25.

In an Office action dated December 7, 1999, the Examiner withdrew claims 26-30 from further consideration as drawn to a non-elected invention, and required election of species for prosecution from then-pending claims 1-25. Following the Applicants' election, claims 6-8, 11 and 25 were withdrawn from consideration as drawn to a non-elected species, and claims 1-5, 9-10 and 12-24 were rejected, in an Office action dated March 30, 2000. Claims 26-30 were cancelled by the Applicants in a response dated July 31, 2000.

Claims 1-5, 9-10 and 12-24 were rejected in a final Office action dated October 25, 2000. Applicants requested a Continued Prosecution Application on March 26, 2001, together with a preliminary amendment by which claims 31-34 were added.

Subsequently, claims 1-5, 9-10, 12-24 and 31-34 were rejected in an Office action dated July 3, 2001. In a response dated October 1, 2001, claim 33 was cancelled. Claims 1-5, 9-10, 12-24, 31-32 and 34 and were rejected in a final Office action dated December 31, 2001.

Accordingly, claims 1-5, 9-10, 12-24, 31-32 and 34 are the subject of this Appeal. A copy of the pending claims is set forth in the Appendix attached hereto.

STATUS OF AMENDMENTS

No claim amendments have been presented after final rejection. All prior claim amendments have been entered by the Examiner. The claims listed in the Appendix reflect all amendments presented in the course of prosecution.

SUMMARY OF THE INVENTION

The present invention is a heat exchanger that utilizes active fluid transport to distribute a fluid through a highly distributed system of small, discrete flow channels (specification, page 4 at lines 23-25). The present invention also provides a method for using the heat exchanger to transfer heat between a heat transfer fluid and another media. Appealed claims 1-5, 9-10, 12-20, 31-32 and 34 are directed to the novel heat exchanger. Appealed claims 21-24 are directed to the method.

The flow channels of the heat exchanger are microchannels that are formed from a polymeric film layer having a microstructured surface (specification, page 5 at lines 7-9). Fig. 3a depicts an end view of a microstructured layer **12** suitable for use in the heat exchanger. In the heat exchanger, the microstructured surface is covered by a layer of

thermally conductive material to produce a plurality of the substantially discrete flow channels (specification, page 5 at lines 19-21). Fig. 4 depicts an end view of a stack of microstructured layers **12**, each covered by a cover layer **20** to form flow channels **16**. The flow channels of the active transport heat exchanger have a minimum aspect ratio of about 10:1 and a hydraulic radius no greater than about 300 micrometers (specification, page 6 at lines 14-17).

The heat exchanger includes a manifold for supplying or receiving fluid (specification, page 6 at lines 25-27). A potential source is applied to the heat exchanger for the purpose of causing active fluid transport through the flow channels (specification, page 5 at lines 21-23). Preferably the source is provided external to the microstructured surface (specification, page 5 at lines 24-25). Fig. 1 depicts an active transport heat exchanger in accordance with the present invention, including manifold **18** and potential source **14** in addition to microstructured layer **12** and cover layer **20**.

The use of a microstructured film layer in the heat exchanger enables the potential source to be highly distributed across the plurality of flow channels (specification, page 5 at lines 26-28). The microchanneled structure advantageously reduces flow stagnation in the fluid and promotes uniform residence time in the heat exchanger (specification, page 6 at lines 1-5), which minimizes non-uniformities in the heat load that the fluid experiences (specification, page 20 at lines 5-8). Another advantage of the present invention is that the use of the microstructured film layer provides a high contact heat transfer surface area per unit volume of fluid, which increases the efficiency of the heat exchanger (specification,

page 6 at lines 7-9). This advantage is even greater for certain embodiments of the invention, which provide a flexible heat exchanger (specification, page 20 at lines 23-26).

ISSUES ON APPEAL

Claims 1, 21, 31-32 and 34 stand rejected by the Examiner under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 4,894,709 to Phillips, *et al.* ("Phillips '709").

Claims 1, 21-23, 31-32 and 34 stand rejected by the Examiner under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 5,771,964 to Bae ("Bae '964").

Claims 1-5, 9-10, 12-23, 31-32 and 34 stand rejected by the Examiner under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 4,347,896 to Rosman ("Rosman '896") in view of Bae '964.

Claims 14 and 24 were rejected by the Examiner under 35 U.S.C. § 103(a) as unpatentable over Rosman '896 in view of Bae '964, and further in view of U.S. Patent 5,249,359 to Schubert, *et al.* ("Schubert '359").

In view of these rejections, the issues on appeal are:

A. Whether claims 1, 21, 31-32 and 34 are patentable over Phillips '709;

B. Whether claims 1, 21-23, 31-32 and 34 are patentable over Bae '964;

C. Whether claims 1-5, 9-10, 12-23, 31-32 and 34 are patentable over Rosman '896 in view of Bae '964;

D. Whether claims 14 and 24 are patentable over Rosman '896 in view of Bae '964, and further in view of Schubert '359.

GROUPING OF CLAIMS

Applicants contend, for the purposes of this Appeal only, that the appealed claims fall into the following groups:

For the rejection over Phillips '709: claims 1 and 21 stand or fall as a group; each of claims 31, 32 and 34 stands or falls independently.

For the rejection over Bae '964: claims 1 and 21-23 stand or fall as one group; each of claims 31, 32 and 34 stands or falls independently.

For the rejection over Rosman '896 in view of Bae '964: claims 1-5, 9-10, 12-14 and 21-23 all stand or fall as one group; claims 15, 18 and 32 stand or fall as one group; claims 16-17 and 19-20 stand or fall as one group; each of claims 31 and 34 stands or falls independently.

For the rejection over Rosman '896 in view of Bae '964 and Schubert '359: each of claims 14 and 24 stands or falls independently.

ARGUMENT

A. Claims 1, 21, 31-32 and 34 Are Patentable Over Phillips '709.

Claims 1, 21, 31-32 and 34 were rejected under 35 U.S.C. § 103(a) as unpatentable over Phillips '709.

Claim 1 of the present application is directed to a heat exchanger for use with active fluid transport, and recites three elements: i) a first layer of polymeric film material having a

structured surface forming a plurality of flow channels of recited dimensions; ii) a cover layer that covers at least a portion of the flow channels of the first layer; and iii) a manifold in fluid communication with the flow passages. Claims 31-32 and 34 depend from claim 1, each reciting additional elements that patentably distinguish the invention over Phillips '709. Claim 21 recites a method of transferring heat between a heat transfer fluid and another media, comprising the step of providing a heat exchanger including a first layer of polymeric film material having a structured surface forming a plurality of flow channels of recited dimensions.

Phillips '709 reports a microchannelled heat sink useful for cooling a high power electronic device, such as an integrated circuit. The heat sink operates by the passage of a liquid through channels of the heat sink. The heat sink of Phillips '709 is preferably made from a semiconductive indium phosphide substrate (col. 7 at lines 54-55), and is formed by precision sawing or etching (col. 2 at lines 11-13). The only useful classes of materials suggested by Phillips '709 for fabricating heat sinks are semiconductor substrates such as silicon, germanium, gallium arsenide or indium phosphide, or metallic substrates such as aluminum, copper or silver (col. 11 at lines 58-61).

The Office action asserts that Phillips '709 discloses all the claimed elements of the present invention except the first layer being a polymeric film material, and that it would have been an obvious design choice to substitute polymeric film material in place of the semiconductor or metallic plates disclosed in Phillips'709.

1. Phillips '709 Does Not Teach or Suggest Each and Every Limitation of the Claimed Invention.

In an obviousness determination under 35 U.S.C. § 103(a), the invention must be considered as a whole and compared to the prior art. All the claim elements must be taught or suggested by the prior art in order for the claim to be obvious. The Applicants' claimed invention is an active fluid transport heat exchanger including a first layer of polymeric film material having a structured surface forming a plurality of flow channels of recited dimensions. Phillips '709 reports only that relatively hard substances, such as semiconductors or metals, can be used in the disclosed heat sink, and that sawing or etching would be the methods most likely employed for fabrication of the heat sink. Phillips '709 does not teach or suggest the use of a polymeric film material to form flow channels in a heat exchanger.

The Applicants have fabricated and claimed an active fluid transport heat exchanger including a polymeric film layer, which confers benefits for the resulting heat exchanger, such as flexibility in some embodiments. The Applicants have demonstrated a suitable method that can be used to fabricate a heat exchanger from a material (i.e., polymeric film) that is entirely different from those reported in Phillips '709 (i.e., metals and semi-conductors).

One method suitable for making the Applicants' claimed invention is casting of a molten polymer on a microstructured nickel casting tool (specification, page 24 at lines 14-16). A person having ordinary skill in the art would recognize that the sawing or etching methods disclosed in Phillips '709 would not be appropriate methods for forming

microchanneled structure in a polymeric film material. Thus, in order to arrive at the claimed invention from Phillips '709, a person of ordinary skill in the art would be at least required to 1) substitute polymeric film material for the metal or semiconductor substrates shown in Phillips '709, and 2) establish a method of forming microchanneled structure in the polymeric film material.

The Applicants' inventive active fluid transport heat exchanger is simply not within the contemplation of the materials or processes taught or suggested in Phillips '709. The reference cited by the Examiner is deficient for at least the reason that it does not demonstrate the use of microchanneled polymeric film material. The reference does not teach or suggest each of the claimed elements, and therefore, the Applicants' invention as claimed in claim 1 and 21 is not obvious in view of Phillips '709.

2. The Reasoning of *In re Leshin* Does Not Support The Conclusion That the Claimed Invention Is Obvious.

Since the cited reference is deficient in not demonstrating the use of polymeric film material, the Examiner asserts that the substitution of polymeric film material into the heat sink of Phillips '709 in place of the disclosed metallic or semiconductive plates would be an obvious design choice. In making this assertion, the Examiner relies on *In re Leshin*, 277 F.2d 197 (C.C.P.A. 1960), a copy of which is attached. The Examiner cites *Leshin* to provide the required rationale for this argued substitution. On the basis of *Leshin*, the Examiner asserts that it is within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use, thus making the choice obvious. However, this is an overly broad and unsupportable reading of the decision in *Leshin*.

In *Leshin*, the applicant's claims at issue were directed to a cosmetics dispenser formed from plastic. The prior art included a similar dispenser, also made from a plastic. The applicant argued that, although the plastic he used and claimed was well known, he had to select the specific plastic that was most suitable for his particular purpose, and therefore the choice was non-obvious. Judge Rich of the CCPA rejected this argument outright, stating that

> Mere selection of *known plastics* to make a container-dispenser of a type *made of plastics prior to the invention*, the selection of the *plastics* being on the basis of suitability for the intended use, would be entirely obvious; and in view of 35 U.S.C. 103 it is a wonder that the point is even mentioned.

Id. at 199 (emphasis added).

As indicated in the portion of the decision quoted above, a critical fact in that case was that the prior art taught dispensers that were fabricated *from plastic*. Inventor Leshin then merely chose *another, known plastic* for his dispenser, and limited his claims to the plastic that was most suitable for his particular purpose. It was obvious, in the eyes of the CCPA, for inventor Leshin to choose a different *known plastic*, when it was already known and demonstrated in the art, prior to the invention by Leshin, that the dispenser could be made from plastic.

It would be a broad reading of the case, however, to say that it would have been obvious for inventor Leshin to choose *any* material with desirable attributes that was suitable for his particular purpose. The *Leshin* decision merely states that it was obvious to choose the most suitable *plastic* from the class of *known plastics*, when it is already taught in the prior art that the claimed dispenser can be formed from *plastic*. There is no indication from the

facts or the wording of the case that a claim to a device made from *another type of material altogether* would be obvious, just because the particular material selected is more suitable for an intended purpose.

The *Leshin* case is inapposite to the present application. What is claimed in the present application is an active fluid transport heat exchanger comprising polymeric film material as a first layer. Phillips '709 does *not* establish that the claimed heat exchanger was made from polymeric film material prior to the invention of the Applicants. Phillips '709 does not teach or suggest a heat exchanger having a first layer of polymeric film material. The heat sink of Phillips '709 is preferably made from an indium phosphide substrate and is formed by precision sawing or etching (col. 2 at lines 11-13). The only classes of materials suggested by Phillips '709 are semiconductor substrates such as silicon, germanium, gallium arsenide or indium phosphide, or metallic substrates such as aluminum, copper or silver (col. 11 at lines 58-61).

Under the holding of *Leshin*, what may be obvious in view of Phillips '709 would be for one skilled in the art of integrated circuits to make a heat sink out of germanium or another hard semiconductor or metallic substrate, where the choice is motivated by the particular purpose envisioned by the skilled worker. For example, if the worker required a different band gap than indium phosphide would provide, he might choose gallium arsenide for fabricating the heat sink reported in Phillips '709, and the choice might be obvious under the reasoning of *Leshin*.

Fabricating a known apparatus from a *different class of materials altogether*, even where the choice of material is informed by the particular application envisioned by the

inventor, is *not* an obvious design choice when the cited prior art does not teach or suggest the desirability of choosing that class of materials. The reasoning of *Leshin* does not apply to the present circumstance, where Phillips '709 reports only the use of metals or semiconductors, and not the polymeric material that is required by the Applicants' claims.

The Examiner has not provided a rationale for the substitution, which is required to make out a *prima facie* case of obviousness. *Leshin* does not provide the missing rationale. The rejection is improper, and should be reversed.

3. Claims 31, 32 and 34 Recite Additional Elements That Patentably Distinguish Embodiments of the Invention From Phillips '709.

Claim 31 depends from claim 1 and is directed to an embodiment of the invention wherein the first layer of polymeric film material is microreplicated. As defined in the specification, the term "microreplicated" indicates that the structured surface features retain an individual feature fidelity during manufacture that varies from product to product no more than about 50 μm (specification, page 21 at lines 13-18). As used in claim 31, the term "microreplicated" refers to a characteristic of the material used in fabricating the embodiment, not to the method of fabrication. As this attribute of a heat exchanger is not taught or suggested by Phillips '709, the reference cannot make the claim obvious.

Claim 32 depends from claim 1 and further recites that the first cover layer has greater thermal conductivity than the polymeric film material of the first layer. Phillips '709 does not teach or suggest the use of layers having different thermal conductivities, nor does it teach the desirability of using layers having different thermal conductivities. Therefore, Phillips '709 cannot render the claim obvious.

Claim 34 depends from claim 1 and further recites that the heat exchanger can conform about a mandrel that has a diameter of at least about one centimeter, without significantly constricting flow through the flow passages. Phillips '709 reports only heat sinks made from relatively rigid materials such as semiconductors or metals, and does not suggest that a flexible heat exchanger can be made. The Applicants have fabricated and claimed an active fluid transport heat exchanger using a polymeric film layer, which confers flexibility for the claimed embodiment.

The Examiner takes the position that the advantageous properties of the Applicants' claimed heat exchanger are merely a consequence of an obvious design substitution, flowing from the inherent properties of the chosen material. It is improper for the Examiner to look in hindsight and deem the invention obvious, simply because flexibility or some other property might be expected from a heat exchanger made using polymeric film material, *especially* where the prior art cited does not teach or suggest that the heat exchanger can be made from polymeric film material, or teach or suggest that it would be desirable to use polymeric film material. Only the present specification teaches a heat exchanger made from polymeric film material, and only the present specification demonstrates a flexible heat exchanger meeting the elements of the claim. Therefore, Phillips '709 cannot render the claim obvious.

For the reasons presented, claims 1, 21, 31-32 and 34 are patentable over Phillips '709, and Applicants respectfully request reversal of the rejections.

B. Claims 1, 21-23, 31-32 and 34 Are Patentable Over Bae '964.

Claims 1, 21-23, 31-32 and 34 were rejected under 35 U.S.C. § 103(a) as unpatentable over Bae '964.

Claim 1 of the present application is directed to a heat exchanger for use with active fluid transport, and recites three elements: i) a first layer of polymeric film material having a structured surface forming a plurality of flow channels of recited dimensions; ii) a cover layer that covers at least a portion of the flow channels of the first layer; and iii) a manifold in fluid communication with the flow passages. Claims 31-32 and 34 depend from claim 1, each reciting additional elements that patentably distinguish the invention over Bae '964. Claim 21 recites a method of transferring heat between a heat transfer fluid and another media, including the step of providing a heat exchanger including a first layer of polymeric film material having a structured surface forming a plurality of flow channels of recited dimensions. Claims 22-23 depend from claim 21, and stand or fall with claim 21.

Bae '964 reports a heat exchanger comprising conduit tubes with serpentine fins running between the tubes. The only materials contemplated for fabrication of the Bae '964 heat exchanger are aluminum and copper (col. 4 at lines 50-51 and 60), metals having superior thermal conductivity. The Bae '964 heat exchanger is made rigid by brazing the serpentine fins to the conduit tubes (col. 4 at lines 58-59).

The final Office action asserts that Bae '964 discloses all the claimed elements except the first layer being a polymeric film material, and that it would have been an obvious design choice to substitute polymeric material in place of the materials disclosed in Bae '964.

<u>1. Bae '964 Does Not Teach or Suggest Each and Every Limitation of the Claimed Invention.</u>

In an obviousness determination under 35 U.S.C. § 103(a), the invention must be considered as a whole and compared to the prior art. All the claim elements must be taught or suggested by the prior art. The Applicants' claimed invention is an active fluid transport heat exchanger including a first layer of polymeric film material having a structured surface forming a plurality of flow channels of recited dimensions. As the Examiner has recognized, Bae '964 does not report the use of a layer of polymeric film material.

There is absolutely no teaching or suggestion in Bae '964 that a microchanneled active fluid transport heat exchanger could be formed from polymeric film material. Bae '964 reports only that relatively rigid substances, such as metals, can be used to make the disclosed heat exchanger. The Applicants have fabricated a heat exchanger from a material (i.e., polymeric film) that is entirely different from those reported in Bae '964. The Applicants' heat exchanger is not within the contemplation of the materials or processes taught or suggested in Bae '964. Therefore, the Applicants' invention as claimed in claim 1 and 21 is not obvious in view of Bae '964.

<u>2. The Rationale of *In re Leshin* Does Not Support The Conclusion That the Claimed Invention Is Obvious.</u>

Since Bae '964 is admitted by the Examiner to be deficient in not demonstrating the use of polymeric film material, the final Office action asserts that it would have been an obvious design choice to substitute polymeric material in place of the materials disclosed in Bae '964 to arrive at the claimed invention. In making the rejection, the Examiner again

relied on the *Leshin* case. For the same reasons presented above with regards to the rejection over Phillips '709, *Leshin* cannot be read to mean that any choice of material is obvious when the choice is made with a particular purpose in mind. *Leshin* stands only for the proposition that it is obvious to choose another known material from a class of materials that has previously been used for fabricating a known apparatus, where the choice is motivated by the suitability for the intended use.

Bae '964 does *not* establish that the claimed heat exchanger was made from either polymeric material or any film material prior to the invention of the Applicants. Bae '964 does not teach or suggest a heat exchanger having a first layer of polymeric film material. The heat exchanger of Bae '964 is preferably made from aluminum and copper (col. 4 at lines 50-51 and 60). The only classes of materials suggested by Bae '964 are metals of superior thermal conductivity, including aluminum and copper.

By way of example, under the reasoning of the *Leshin* case it might be obvious to fabricate the Bae '964 heat exchanger from titanium, another metal with high thermal conductivity, if one desires to reduce the weight or increase the strength of the heat exchanger. It is not *prima facie* obvious, however, to fabricate a heat exchanger from an *entirely different* class of material, such as polymeric film material. The Applicants have fabricated and claimed an active fluid transport heat exchanger using a polymeric film layer, which confers benefits for the resulting heat exchanger, such as flexibility in some embodiments.

Fabricating a known apparatus from a *different class of materials altogether*, even where the choice of material is informed by the particular application envisioned by the

inventor, is *not* an obvious design choice when the cited prior art does not teach or suggest the desirability of choosing that class of materials. The reasoning of *Leshin* simply does not apply to the present circumstance, where the prior art reference cited by the Examiner reports only the use of metals, and not the polymeric film material that is recited in Applicants' claims. It is improper for the Examiner to look in hindsight and deem the invention obvious, simply because flexibility or some other property might be expected from a heat exchanger made using polymeric film material, when the cited prior art does not teach or suggest the use or the desirability of using polymeric film material. The rejection is improper, and should be reversed.

3. Claims 31, 32 and 34 Recite Additional Elements That Patentably Distinguish the Invention From Bae '964.

Claim 31 depends from claim 1 and is directed to an embodiment of the invention wherein the first layer of polymeric film material is microreplicated. As defined in the specification, the term "microreplicated" indicates that the structured surface features retain an individual feature fidelity during manufacture that varies from product to product no more than about 50 μm (specification, page 21 at lines 13-18). As used in the claim, the term "microreplicated" refers to a characteristic of the material used in fabricating the embodiment, not to the method of fabrication. As this attribute of a heat exchanger is not taught or suggested by Bae '964, the reference cannot make the claim obvious.

Claim 32 depends from claim 1 and further recites that the first cover layer has greater thermal conductivity than the polymeric film material of the first layer. Bae '964 does not teach or suggest the use of layers having differing thermal conductivities, nor does it

teach the desirability of using layers having different thermal conductivities. Therefore, Bae '964 cannot render the claim obvious.

Claim 34 depends from claim 1 and further recites that the heat exchanger can conform about a mandrel that has a diameter of at least about one centimeter, without significantly constricting flow through the flow passages. Bae '964 reports only a heat exchanger made from relatively rigid material such as metal, and does not suggest that a flexible heat exchanger can be made. Rather, Bae '964 clearly teaches away from a flexible heat exchanger, since the reported heat exchanger is made rigid by brazing the serpentine fins to the conduit tubes (col. 4 at lines 58-59). Therefore, Bae '964 does not make the claimed invention obvious.

For the reasons presented, claims 1, 21-23, 31-32 and 34 are patentable over Bae '964, and Applicants respectfully request reversal of the rejection.

C. Claims 1-5, 9-10, 12-23, 31-32 and 34 Are Patentable Over the Combination of Rosman '896 in View of Bae '964.

Claims 1-5, 9-10, 12-23, 31-32 and 34 were rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 4,347,896 to Rosman, *et al.* in view of Bae '964.

Claim 1 of the present application is directed to a heat exchanger for use with active fluid transport, and recites three elements including: i) a first layer of polymeric film material having a structured surface forming a plurality of flow channels of recited dimensions; ii) a cover layer that covers at least a portion of the flow channels of the first layer; and iii) a manifold in fluid communication with the flow passages. Claims 2-5, 9-10 and 12-14 depend

from claim 1, and stand or fall with claim 1. Claims 15-17, 18-20, 31-32 and 34 depend from claim 1, each reciting additional elements that patentably distinguish the invention over the cited reference. Claim 21 recites a method of transferring heat between a heat transfer fluid and another media, including the step of providing a heat exchanger including a first layer of polymeric film material having a structured surface forming a plurality of flow channels of recited dimensions. Claims 22-23 depend from claim 21, and stand or fall with claim 21.

Rosman '896 reports a channeled plate with an internal manifold. The plates can be stacked to form a plate/fin heat exchanger. Rosman '896 does not disclose how the plate may be made, other than stating as an object of the invention that the plate "can be made from a single die" (col. 2 at line 40-41). As the Examiner has noted, Rosman '896 suggests in passing that the plate could be formed from polymer material (col. 8 at lines 41-46).

Bae '964 reports a heat exchanger comprising conduit tubes with serpentine fins running between the tubes. The only materials contemplated for fabrication of the Bae '964 heat exchanger are aluminum and copper (col. 4 at lines 50-51 and 60), metals with superior thermal conductivity. The Bae '964 heat exchanger is made rigid by brazing the serpentine fins to the conduit tubes (col. 4 at lines 58-59).

The Examiner concludes that one of ordinary skill in the art might employ the teachings of Rosman '896 to achieve optimal heat exchange in a heat exchanger of Bae '964. The Office action asserts that Rosman '896 reports all the claim elements except for the use of film material and the hydraulic radius and length of the channels. According to the Office action, the missing elements on the hydraulic radius and channel length are provided by Bae '964.

1. The Combination of Rosman '896 and Bae '964 Does Not Enable a Person Having Ordinary Skill in the Art to Make the Claimed Heat Exchanger.

The Applicants' claimed invention is an active fluid transport heat exchanger including a first layer of polymeric film material having a structured surface forming a plurality of flow channels of recited dimensions. The extent of the disclosure in Rosman '896 regarding polymeric material, and of the variability of channel dimensions and plate thickness for optimizing heat transfer, is contained *entirely* within the following passage:

> Depending upon the ultimate use and the desired heat transfer rate, various plate thickness, channel and fin ratios, length and width ratios and various thermally conductive materials can be used. The following materials are delineated by way of example, and not by way of limitation: metals, ceramics, polymers, etc.

(col. 8 at lines 41-46).

No additional discussion of polymeric materials is provided by Rosman '896, nor by the combination of Rosman '896 and Bae '964. No information on how to fabricate a polymeric heat exchanger is provided, and no information is given on which polymeric materials would be suitable or on how to select an appropriate polymeric material. In short, Rosman '896, alone or in combination with Bae '964, does not enable one skilled in the art of heat exchangers to make a heat exchanger from polymeric film material.

Furthermore, no information is given in Rosman '896 on how to fabricate its plate/fin heat exchangers including a plate having microchanneled structure. No dimensional information is provided on the plate thickness, channel width or length, or fin height in the Rosman reference. The reference does not disclose how the plates may be made, other than

stating as an object of the invention that the plates "can be made from a single die" (col. 2 at line 40-41).

Furthermore, the combination does not provide enabling disclosure on how to make a heat exchanger using microstructured polymeric *film* material. Rosman '896 reports that a stack of plates may be assembled by diffusion bonding, brazing, welding or bolt-clamping a plurality of plates (col. 2 at lines 51-54). None of these methods of manufacture would be compatible with the concept of forming a stacked-plate heat exchanger from polymeric *film* material. Therefore, Rosman '896 cannot enable one skilled in the art to make the features of the reported plates on a small scale (i.e., the dimensions reported in Bae '964) using a polymeric film, or to make an active fluid transport heat exchanger from microstructured polymeric film material.

Combining Bae '964 with Rosman '896 does not cure the deficiencies. The methods of manufacturing the Bae '964 heat exchanger include "bending" and "folding" a plate of metal (such as aluminum or copper) to form flow channels by covering a plurality of "upstanding walls." The plate is then "brazed" to the top edges of the upstanding walls. (See col. 5 at lines 41-52.) The described methods would not be useful in working with polymeric film material, and therefore do not enable a person having ordinary skill in the art to make an active fluid transport heat exchanger from polymeric film material.

As discussed above, one method of forming the Applicants' claimed invention from polymeric film material is by casting of molten polymeric material onto a microstructured nickel casting tool. Only the present application teaches and enables the use of polymeric film material in a microchanneled heat exchanger. The combination of Rosman '896 and Bae

'964 does not enable a person skilled in the art to make the claimed microchanneled heat exchanger from polymeric film material. This combination, taken as a whole, would leave a person skilled in the art at a complete loss as to how to make a microstructured heat exchanger from a polymeric film material. Therefore, the Applicants' invention is not obvious in view of the combination of Rosman '896 and Bae '964, and the rejection should be reversed.

2. The Combination of Rosman '896 and Bae '964 Does Not Provide the Claimed Invention.

In combination, Rosman '896 and Bae '964 cited by the Examiner do not provide a teaching or suggestion to make the heat exchanger of Bae '964 from polymeric *films*. Rosman '896 reports that the plate is made using a die (col. 2 at lines 40-41) and that a stack of plates may be assembled by diffusion bonding, brazing, welding or bolt-clamping a plurality of plates (col. 2 at lines 51-54). None of those methods of manufacture are compatible with the concept of forming the reported stacked-plate heat exchanger from polymeric film material. Rather, those methods are useful for manipulating rigid metals, such as aluminum and copper, that are reported by the reference.

Furthermore, by equating the plates of Rosman '896 with the film material of the present invention, the Examiner ignores the generally understood distinction between a "plate" and a "film." The term "plate" is defined by *The American Heritage Dictionary, Second College Edition* (Houghton Mifflin Company, Boston, Mass.) as, "A smooth, flat, relatively thin, *rigid* body of uniform thickness" (emphasis added). In contrast, as defined in

the present specification, the term "film" refers to a thin, generally *flexible* sheet of polymeric material (specification, page 22 at lines 24-26).

The Examiner argues that the statement in Rosman '896 that "various plate thickness...can be used" (col. 8 at lines 42-44) would suggest to one skilled in the art that the plate could be made any desired thickness, and therefore the "film" of the present invention is provided by the reference. However, this argument simply magnifies the fact that the Examiner has improperly equated the plates of the prior art to the polymeric film material of the present invention, since the character of a plate and a film are completely opposed. Furthermore, the argument also ignores the fact that a rigid material, even made thin, often remains rigid and inflexible. Therefore, even assuming *arguendo* that Rosman '896 suggests making the plates as thin as the film material of the present invention, it still provides no teaching or suggestion for using a polymeric film material, or of the desirability of using polymeric film material. Nowhere in Rosman '896 is there a suggestion to use film material; only the term "plate" is used in Rosman '896.

In light of the general recital (as quoted above) that the plates may be made from polymeric material, Rosman '896 might *at most* motivate one to make a plate for a heat exchanger from a *rigid* polymeric material in the same dimensional scale as its plates. Rosman '896 clearly states that the fins and channels of the plates are designed to enhance structural integrity (col. 5 at lines 40-43 and 52-55). Rosman '896 suggests using a die to form plates from a rigid material, which could then be bonded or clamped together to form a bulky heat exchanger. Even importing the size limitations provided by Bae '964, the combination still only teaches or suggests rigid components.

In contrast, the polymeric film material recited in the claims of the present invention is a thin, generally flexible sheet of polymeric material (specification, page 22 at lines 24-26) which provides a flexible heat exchanger in some embodiments, whereas a rigid embodiment can be made by including a *separate* supporting body (specification, page 22 at line 27, bridging to page 23 at line 2). The combination does not provide each element of the claimed invention, and so the rejection is improper and should be reversed.

3. No Motivation for Combining the Teachings of Rosman '896 and Bae '964 Existed Prior to the Invention by the Applicants.

In order for a combination of references to be proper, the combination must suggest the desirability of making the combination; see *In re Rouffet*, 149 F.3d 1350 (Fed. Cir. 1998). Even if the disclosed embodiments contained in the cited references can be physically modified, there must also exist a suggestion in the prior art that the modification is desirable; see *In re Mills*, 916 F.2d 680 (Fed. Cir. 1990). No such motivation existed in the art to either combine or modify the teachings of Rosman '896 and Bae '964, until the disclosure by the Applicants.

The Examiner asserts that one of ordinary skill in the art would employ the teachings of Bae '964 to achieve optimal heat exchange in the stacked-plate heat exchanger of Rosman '896; however, there is no indication in either reference that heat exchange can be *optimized* by utilizing a polymeric material. The combination cited by the Examiner gives no indication that there would be any desirable modification that could be obtained by the combination.

Rather, one skilled in the art would in fact recognize that better thermal conductivity is generally obtained using a metallic material, as indicated by *both* Rosman '896 and Bae

'964. Many polymers are poor thermal conductors, as compared with metals. Therefore, one skilled in the art would not choose a polymeric material, if he desired to optimize heat exchange. Although Rosman '896 states that polymer material could be used, it does not indicate the *desirability* to make the modification of using either polymeric material, or polymeric film material. Therefore, the Examiner's assertion that one of ordinary skill in the art would employ the teachings of Bae '964 to achieve optimal heat exchange in the heat exchangers of Rosman '896 is not supported by a teaching in the combination that the modification is desirable.

It is improper to take the motivation for a suggested combination from the nature of the problem to be solved; see *In re Zurko*, 111 F.3d 887 (Fed. Cir. 1997). Therefore, one cannot conclude that the skilled artisan, focused on the objective of forming a heat exchanger having an improved contact heat transfer surface area per unit volume of fluid, would combine the teachings of Rosman '896 and Bae '964 to arrive at the claimed invention. Neither reference suggests the desirability of the modification of using polymeric material to form a heat exchanger. Neither reference suggests that a heat exchanger could be made from polymeric *film* material. Neither suggests that a *flexible* heat exchanger could be made from any class of material, unlike certain embodiments of the Applicants' invention. The Applicants, on the other hand, have invented and claimed an active fluid transport heat exchanger using polymeric film material, which provides flexibility and an improved contact heat transfer surface area per unit volume of fluid to some embodiments.

Unless the specific problem that is the inventor's focus is identified in the prior art, the missing elements cannot be inferred from the nature of the problem to be solved; *Id.* at

890. To do so is to use impermissible hindsight to arrive at the claimed invention; *Id.* at 889. The Examiner has improperly used hindsight in this case. The Examiner has used the teachings of the Applicants' specification to provide a basis for the motivation to combine references, where the motivation is not set forth in the references themselves.

As there is no motivation for combining the references, the proposed combination of Rosman '896 in view of Bae '964 cannot render the Applicants' invention obvious. Reversal of the rejection is solicited.

4. Claims 15-17, 18-20, 31, 32 and 34 Recite Additional Elements That Patentably Distinguish the Invention From the Combination of Rosman '896 and Bae '964.

Claims 15, 18 and 32 depend ultimately from claim 1 and are directed to embodiments of the invention wherein the first cover layer is more thermally conductive than the first layer of polymeric film material (claim 15), or wherein the first cover layer has greater thermal conductivity than the polymeric film material of the first layer. Neither Rosman '896 nor Bae '964 teaches or suggests the use of layers or materials having differing thermal conductivities, nor does it teach the desirability of using layers or materials having different thermal conductivities. Therefore, the combination of reference cannot render the claim obvious.

Claims 16-17 and 19-20 depend ultimately from claim 1 and are directed to embodiments wherein the polymeric film material is covered by a cover layer including metal within its composition. Neither Rosman '896 nor Bae '964 teaches or suggests the use of layers of different materials, nor does it teach the desirability of using layers of different materials. Coupling a metal-containing conductive layer to the polymeric film material layer

results in a heat exchanger that exhibits good heat exchange properties through the cover layer, while the microstructured polymeric layer provides structural integrity under an applied force (specification, page 5 at lines 12-15). Since this desirable feature is not taught or suggested by the combination of references, the combination cannot render the claim obvious.

Claim 31 depends from claim 1 and is directed to an embodiment of the invention wherein the first layer of polymeric film material is microreplicated. As defined in the specification, the term “microreplicated” indicates that the structured surface features retain an individual feature fidelity during manufacture that varies from product to product no more than about 50 μm (specification, page 21 at lines 13-18). As used in the claim, the term “microreplicated” refers to a characteristic of the material used in fabricating the heat exchangers, not to the method of fabrication. As this attribute of a heat exchanger is not taught or suggested by either Rosman ’896 or Bae ’964, the combination cannot make the claim obvious.

Claim 34 depends from claim 1 and further recites that the heat exchanger can conform about a mandrel that has a diameter of at least about one centimeter, without significantly constricting flow through the flow passages. Bae ’964 reports only a heat exchanger made from relatively rigid material such as metal, and does not suggest that a flexible heat exchanger can be made. Bae ’964 in fact teaches away from a flexible heat exchanger, since the reported heat exchanger is made rigid by brazing the serpentine fins to the conduit tubes (col. 4 at lines 58-59). Rosman ’896 reports that its plates are made using a die (col. 2 at lines 40-41) and that a stack of plates may be assembled by diffusion bonding,

brazing, welding or bolt-clamping a plurality of plates (col. 2 at lines 51-54). None of those methods of manufacture would be compatible with the concept of forming the reported stacked-plate heat exchanger to form a flexible heat exchanger. Therefore, the references, alone or in combination, cannot make the claimed invention obvious.

For the reasons presented, each claim is patentable over the combination of Rosman '896 and Bae '964, and Applicants respectfully request reversal of the rejection.

D. Claims 14 and 24 Are Patentable Over the Combination of Rosman '896, Bae '964 and Schubert '359.

Claims 14 and 24 were rejected under 35 U.S.C. § 103(a) as unpatentable over Rosman '896 in view of Bae '964 and further in view of Schubert '359.

Claim 14 depends ultimately from claim 1. As discussed above, the Applicants' claim 1 is not obvious in view of the combination of Rosman '896 and Bae '964. Schubert '359 does not provide the elements missing from the combination of Rosman '896 and Bae '964. As claim 14 depends from a patentable claim and recites additional elements, it too is allowable.

Claim 24 depends ultimately from claim 21. As discussed above, the Applicants' claim 21 is not obvious in view of the combination of the Rosman and Bae references. Schubert '359 does not provide the elements missing from the combination of Rosman '896 and Bae '964. As claim 24 depends from a patentable claim and recites additional elements, it too is allowable.

Therefore, Applicants respectfully request reversal of the rejection.

CONCLUSION

The references cited by the Examiner fail to teach or suggest recited elements of the claimed invention, namely, the use of a structured layer of polymeric film material to form flow channels in an active fluid transport heat exchanger. The Examiner's reliance on *In re Leshin* is misplaced, and routine design choice does not provide claim elements that the cited prior art lacks. Furthermore, the references cited by the Examiner do not enable a person having ordinary skill in the art to make an active fluid transport heat exchanger that meets each and every element of the Applicants' claims. The Examiner has impermissibly used hindsight to combine and modify the teachings of the references in order to meet the elements of the claimed invention, since only the Applicants' disclosure teaches and enables the use of polymeric film material in a microchanneled heat exchanger.

Accordingly, pending claims 1-5, 9-10, 12-24, 31-32 and 34 are allowable over the prior art of record. Applicants respectfully requests that the Board reverse the outstanding rejection of the pending claims, and that the application be returned to the Examiner for processing in accordance with that reversal.

The appropriate fee of $320.00 for the filing and consideration of this Appeal Brief is enclosed. Should any additional fee be required, the Commissioner is authorized to charge our Deposit Account No. 06-0029 and is requested to notify us of the same.

Respectfully Submitted,

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APPENDIX

PENDING CLAIMS

1. A heat exchanger for use with active fluid transport, comprising:

(a) a first layer of polymeric film material having first and second major surfaces, wherein the first major surface includes a structured surface having a plurality of flow channels that extend from a first point to a second point along the surface of the first layer and that have a minimum aspect ratio of the channel's length to its hydraulic radius of about 10:1 and a hydraulic radius of no greater than about 300 micrometers;

(b) a first cover layer that overlies at least a portion of the structured polymeric surface and includes a closing surface to cover at least a portion of the plurality of flow channels to make plural substantially discrete flow passages; and

(c) a manifold in fluid communication with the substantially discrete flow passages to allow a potential from a potential source to promote fluid movement through the passages from a first potential to a second potential, such fluid movement for thermally affecting the first cover layer of material for promoting heat transfer between the moving fluid and the first cover layer.

2. The heat exchanger of claim 1, wherein said first cover layer comprises a second layer of polymeric film material having first and second major surfaces, the first major surface of the second layer including a structured surface having a plurality of flow channels, and the second major surface of the second layer providing the closing surface making the plural substantially discrete flow passages of the first layer.

3. The heat exchanger of claim 2, further comprising at least one additional layer of polymeric film material having first and second major surfaces, the first major surface of each additional layer including a structured surface having a plurality of flow channels, the first, second and additional layers of polymeric film material being stacked on top of one

another to form a stacked array having a plural ordered rows of substantially discrete flow passages.

4. The heat exchanger of claim 1, further comprising a second layer of polymeric film material having first and second major surfaces, the first major surface of the second layer including a structured surface having a plurality of flow channels, the second layer being stacked on top of the first cover layer that overlies the first layer to form a stacked array.

5. The heat exchanger of claim 4, further comprising a second cover layer of material, wherein at least a portion of the second major surface of the second layer of polymeric film material is secured to the first cover layer, and the second cover layer is secured to at least a portion of the structured surface of the second layer of polymeric film material to make substantially discrete flow passages.

6. (Withdrawn from consideration) The heat exchanger of claim 4, wherein at least a portion of the structured surface of the first major surface of the second layer of polymeric material is secured to the second cover layer to cover the flow channels of the second layer of polymeric material to make substantially discrete flow passages.

7. (Withdrawn from consideration) The heat exchanger of claim 6, wherein the flow channels of the first layer of polymeric material and the flow channels of the second layer of polymeric material are substantially linear and are arranged in an angular relationship with respect to one another.

8. (Withdrawn from consideration) The heat exchanger of claim 7, wherein the flow channels of the first and second layers of polymeric material are aligned substantially parallel to each other.

9. The heat exchanger of claim 1, further comprising a plurality of layers of polymeric film material, each of the plurality of layers of polymeric film material having a first major

surface defined by a structured surface formed within the layer, the structured surface having a plurality of flow channels that extend from a first point to a second point along the surface of the layer, the plurality of flow channels having a minimum aspect ratio of the channel's length to its hydraulic radius of about 10:1 and a hydraulic radius of no greater than about 300 micrometers, and wherein the plurality of layers of polymeric film material and the first cover layer are arranged in a stacked array, with the first cover layer interposed between an adjacent pair of layers of polymeric film material so that the first cover layer covers at least a portion of the structured surface of one of the adjacent pair of layers of polymeric film material to make substantially discrete flow passages.

10. The heat exchanger of claim 9, further comprising a plurality of cover layers interposed between the layers of polymeric film material and covering at least portions of the structured surfaces of such layers of polymeric film material and to make plural ordered rows of substantially discrete flow passages.

11. (Withdrawn from consideration) The heat exchanger of claim 10, wherein each of the plurality of cover layers is interposed between a different pair of adjacent layers of polymeric material so that each cover layer closes the flow channels of the structured surface of one of an adjacent pair of layers of polymeric material to make substantially discrete flow passages.

12. The heat exchanger of claim 9, wherein the flow channels of adjacent layers of polymeric film material are substantially linear and are aligned in an angular relationship to each other.

13. The heat exchanger of claim 12, wherein the flow channels of the adjacent layers are aligned substantially parallel to each other.

14. The heat exchanger of claim 12, wherein the flow channels of the adjacent layers are aligned substantially perpendicular to each other.

15. The heat exchanger of claim 1, wherein the first cover layer is more thermally conductive than the first layer of polymeric film material.

16. The heat exchanger of claim 15, wherein the first cover layer includes metal within its composition.

17. The heat exchanger of claim 16, wherein the first cover layer comprises a metal foil.

18. The heat exchanger of claim 10, wherein the plurality of cover layers are more thermally conductive than the layers of polymeric film material.

19. The heat exchanger of claim 18, wherein the cover layers include metal within their composition.

20. The heat exchanger of claim 19, wherein the cover layers comprise metal foil.

21. A method of transferring heat between a heat transfer fluid and another media that is to be thermally effected in proximity to a heat exchanger, comprising the steps of:

(a) providing a heat exchanger comprising a layer of polymeric film material having first and second major surfaces, wherein the first major surface includes a structured surface having a plurality of flow channels that extend from a first point to a second point along the surface of the layer, and that have a minimum aspect ratio of the channel's length to its hydraulic radius of about 10:1 and a hydraulic radius of no greater than about 300 micrometers;

(b) connecting a source of heat exchange fluid having a predetermined initial temperature to flow passages comprised of the flow channels;

(c) placing the heat exchanger in a position to conduct heat between the other media and the fluid within the heat exchanger; and

(d) providing a source of potential over the flow passages of the heat exchanger, and thereby moving the fluid through the flow passages from a first potential to a second

potential, the movement of the fluid causing heat transfer between the moving fluid and the other media so as to thermally affect the media in proximity to the heat exchanger.

22. The method of transferring heat of claim 21, further including a step of providing a cover layer to a portion of the structured surface of the layer of polymeric film material having a closing surface to cover at least a portion of the flow channels to make plural substantially discrete flow passages, and wherein the cover layer is placed in a position to conduct heat between the other media and the fluid within the heat exchanger.

23. The method of transferring heat of claim 22, wherein the step of placing the heat exchanger with its cover layer in a position to conduct heat between the other media and the fluid within the heat exchanger includes placing the cover layer of the heat exchanger in direct contact with the other media to conduct heat through conduction between the other media and the fluid within the heat exchanger.

24. The method of transferring heat of claim 22, wherein the step of placing the heat exchanger with its cover layer in a position to conduct heat between the other media and the fluid within the heat exchanger includes spacing the cover layer of the heat exchanger apart from the other media to conduct heat through convection between the other media and the fluid within the heat exchanger.

25. (Withdrawn from consideration) The method of transferring heat of claim 22, wherein:

the step of providing a heat exchanger includes providing a heat exchanger having a second layer of polymeric material stacked on top of the cover layer, the second layer of material having a first major surface that includes a structured surface formed within the layer, the structured surface having a plurality of flow channels that extend from a first point to a second point along the surface of the second layer of polymeric material, at least a portion of the flow channels of the second layer being covered by the cover layer to make plural substantially discrete flow passages; and

the step of placing the heat exchanger with its cover layer in a position to conduct heat includes fluidically connecting the flow passages made by the channels of the second layer of polymeric material to a second source of fluid to conduct heat between the second source of fluid and the fluid having a predetermined initial temperature.

26. (Cancelled)

27. (Cancelled)

28. (Cancelled)

29. (Cancelled)

30. (Cancelled)

31. The heat exchanger of claim 1, wherein the first layer is microreplicated.

32. The heat exchanger of claim 1, wherein the first cover layer has greater thermal conductivity than the polymeric film material of the first layer.

33. (Cancelled)

34. The heat exchanger of claim 1, wherein the heat exchanger can conform about a mandrel that has a diameter of at least about one centimeter (about 0.39 inches) without significantly constricting flow through the plurality of flow passages.